

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant: Igor Konyashin et al.  
Serial No: 10/517,661  
Filed: 12/29/2005  
Title: Hard Metal, in Particular for Cutting Stone, Concrete, and Asphalt  
Examiner: Weiping Zhu  
Art Unit: 1742

**Commissioner for Patents**

**Alexandria, VA 22313-1450**

ARGUMENTS ACCOMPANYING  
PRE-APPEAL BRIEF REQUEST FOR REVIEW

Claims 30 to 43, 45 to 49, and 86 stand rejected under 35 U.S.C. 103(a) as being unpatentable over *Heinrich et al.* (US 5,992,546). Claims 44, 50, and 51 stand rejected under 35 U.S.C. 103(a) as being unpatentable over *Heinrich et al.* (US 5,992,546) and *Brandrup-Wognesen* (US 5,723,177).

Examiner states in the final rejection (page 3; response to arguments) that the rejections made are based on the prior art's broad disclosure rather than preferred embodiments as argued by applicant by relying on the Tables 1 and 2 of *Heinrich et al.* Examiner refers to the rejection made in the office action dated 8/23/07 that, based on *In re Best* (MPEP 2112.01 [R3]), where the claimed products and the prior art products are identical or substantially identical in structure or composition or are produced by identical or substantially identical process a prima facie case of either anticipation or obviousness has been established. The examiner furthermore has stated that these conditions apply in the instant case and that the same values of coercive field strength and magnetic saturation would be expected in the tools of *Heinrich et al.* as in the claimed ones.

Applicant submits that the disclosure of the same type of binder and the same

compositional range of the binder does not present a prima facie case of obviousness in regard to substantially identical structure or composition since the structure of the hard metal product does not depend on the **binder alone** but on the **composition of WC (carbon contents) as well as the concentration of W in the binder**.

The present invention proposes to improve both mechanical and performance properties of cemented carbides on the basis of WC by reinforcing the binder phase. This is achieved by **decreasing the carbon content** in the cemented carbides **leading to significantly higher concentration of dissolved tungsten in the binder**; a measure for the dissolved tungsten in the binder in the **magnetic saturation** as claimed in claim 30:

"...wherein the hard metal has a magnetic saturation ( $\sigma$  or  $4\pi\sigma$ , in units of microtesla times cubic meter per kilogram, respectively) as a function of the Co proportion (X) in % by weight of the hard metal in a range of

$$\sigma = 0.11 X \text{ to } \sigma = 0.137 X \text{ or}$$

$$4\pi\sigma = 0.44 \pi X \text{ to } 4\pi\sigma = 0.548 \pi X."$$

The interrelation of the magnetic saturation on the composition and structure of the hard metal is evidenced by the following references submitted in response to the office action dated 8/23/07 (see Information Disclosure Statement filed 12/26/07) :

*B. Roebuck*, Int. J. Refractory Met. Hard Mater. 14 (1996) 419-424;

*Cho et al.*, Interceram. 48 (1999) 30-35;

*Andren*, Material and Design 22 (2001) 491-498.

*Roebuck* discusses that the **magnetic saturation** of the cemented carbide binder and consequently of the cemented carbide itself **is a measure of the amount of tungsten dissolved in the binder** in cemented carbide containing a certain percentage of cobalt. *Roebuck* specifically states that the **amount of tungsten dissolved in the cobalt binder phase can be assessed by measuring the magnetic saturation/magnetic moment because the saturation value of cobalt decreases as more tungsten is added** (compare page 419, right column, lines 7 and 14, of *Roebuck* - see also discussion in the specification, paragraph bridging pages 1 and 2).

*Cho et al.* (see Abstract) and *Andren* (see page 493, heading "3. WC-Co") describe that in cemented carbides the tungsten contents dissolved in the binder

increases significantly as the carbon contents decreases. As carbon content in cemented carbide decreases and the W content dissolved in the binder increases, magnetic saturation of cemented carbide noticeably decreases.

Thus, there is a direct relationship between magnetic saturation on the one hand and the tungsten content in the binder on the other hand. There is also a relationship between the tungsten content in the binder and the carbon contents of WC. In summarizing the above: low carbon -> high tungsten; high tungsten -> decreased magnetic saturation.

Therefore, by providing in claim 30 a value for the magnetic saturation, there is at the same time a measure provided for the W contents in the binder. This is explained also in the instant specification (paragraph bridging pages 1 and 2).

The inventors have surprisingly found that cemented carbides in which the carbon contents is low and the binder has high concentrations of dissolved W (and consequently low values of magnetic saturation), a dramatic increase in wear resistance, transverse rupture strength and performance toughness can be observed.

*Heinrich et al.* employs a conventional tungsten carbide and makes no modifications to the tungsten carbide; the special feature of *Heinrich et al.* resides exclusively in the binder composition. See, for example, Table 1 where WC being used is specified as macrocrystalline WC from Kennametal Inc., Fallon, Nevada (col. 5, lines 10-11). There is no mention in the cited reference that any modification or any change is made to the WC. Only the binder is modified.

The instant hard metals are produced with reduced carbon leading to increased dissolved tungsten in the binder in comparison to conventional cemented carbides such as those of *Heinrich et al.*; the hard metals according to the invention thus have a reduced magnetic saturation (magnetic saturation, as explained above, is a measure of the amount of dissolved tungsten in the binder). The invention claims in claim 30 certain conditions as regards the magnetic saturation which conditions are not fulfilled by *Heinrich et al.*; these conditions reflect the special composition and structure of the hard metal of the present invention that are not disclosed or obvious in view of *Heinrich et al.*

Examples 1, 3 and 4 of the present invention disclose magnetic saturation values  $4\pi\sigma = 7.0; 14.8; \text{ and } 9.4 \mu\text{Tm}^3/\text{kg}$ , respectively, for WC-Co hard metal (6.5 % by weight

and 9.5 % by weight of Co) with low carbon contents in accordance with the present invention.

The magnetic saturation of the cemented carbides with 4.5 % Co according to U.S. 5,992,546 (Tables 1 and 2) is equal to  $17.8 \mu\text{Tm}^3/\text{kg}$  and the magnetic moment  $\sigma$  is equal to  $1.42 \mu\text{Tm}^3/\text{kg}$  at 18 Oe or 1.42 kA/m (Table 2).

In accordance with the claimed range of claim 30 (X = Co contents), the Co contents of 4.5 % by weight should be as follows:

$$\text{lower value } 0.44 \pi X = 6.217 \mu\text{Tm}^3/\text{kg}$$

$$\text{upper value } 0.548 \pi X = 7.743 \mu\text{Tm}^3/\text{kg}$$

and the magnetic moment  $\sigma$  should be 0.495 to  $0.617 \mu\text{Tm}^3/\text{kg}$ .

These magnetic saturation values in the range of 6.22 to  $7.743 \mu\text{Tm}^3/\text{kg}$  for cemented carbide with 4.5 % Co and the magnetic moment  $\sigma$  from 0.495 to  $0.617 \mu\text{Tm}^3/\text{kg}$  as calculated based on claim 30 are significantly lower than the values disclosed in U.S. 5,992,546. The actual value of *Heinrich et al.* of **17.8 of magnetic saturation is more than 2.5 times as high** as the range claimed in claim 30. This is clear evidence that the binder *Heinrich et al.* does not contain tungsten in an amount comparable to that of the present invention. Note that the examples 1, 3, 4 provided in the instant specification also have comparative WC-Co materials of the same Co content but higher carbon content; all comparative materials with high carbon contents have much higher magnetic saturation in comparison to the materials claimed.

The examiner argues that the reference *Heinrich et al.* must be considered for its broad disclosure and cannot be limited to certain examples. The broad disclosure is the use of standard WC, as it is commercially available, in combination with a specific binder. As has been explained above in detail, magnetic saturation is a measure for the tungsten contents in the binder; furthermore, low carbon in WC leads to high tungsten contents in the binder and low magnetic saturation. *Heinrich et al.* nowhere sets forth that the carbon contents of the employed WC is modified, i.e., a low carbon contents that could lead to high tungsten in the binder and low magnetic saturation is not mentioned. The commercially available and conventional WC used by *Heinrich et al.* cannot lead to a high tungsten concentration in the binder. The magnetic saturation of

*Heinrich et al.* shows that the concentration of **tungsten dissolved in the binder** is not within the range according to the present invention. The structure and composition according to the present invention are therefore different and not obvious in view of *Heinrich et al.* The examiner's assertion that the cemented carbides of the invention are prima facie "identical in structure and composition" to the cemented carbide disclosed in U.S. 5,992,546 is incorrect.

The binder of the cemented carbides of the invention can additionally comprise nanoparticles of ordered phases of tungsten, cobalt, and/or carbon (claim 35); this is clearly indicated by TEM results (transmission electron microscope; see page 7, 1st paragraph; see page 9, 4th paragraph, of the specification) so that the microstructure and nanostructure of the cemented carbides of the present invention is completely different from that described in U.S. 5,992,546. It has been surprisingly found that cemented carbide binders comprising nanoparticles of one or several phases of ordered phases of tungsten, cobalt, and/or carbon as claimed in claim 35 provide cemented carbide properties that are dramatically improved.

The claims 44, 50, and 51 depend from claim 30 describing cemented carbides with a certain combination of Co content, coercive field strength, and magnetic saturation; such a combination of features is not disclosed in *Heinrich et al.* and *Brandrup-Wognsen* is silent in regard to these features.

The claims 30-51 and 86 are therefore not obvious in view of the cited references. Reconsideration and withdrawal of the rejection of the claims are therefore respectfully requested.

Respectfully submitted on Juni 5, 2008,

/Gudrun E. Hockett/

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